What is a Riparian Buffer?

Although the definition of riparian areas and buffers may vary depending on the perspective of managers and scientists, various land use settings, and activities carried out in the riparian landscape, the following definitions are provided for the purposes of this plan:

The word *riparian* comes from Latin meaning streambank or shore, and simply refers to land adjacent to a body of water, which serves as a transitional environment that directly affects or is affected by the presence of that water. In this context, a *buffer* is an area maintained in permanent vegetation and managed to reduce the impacts of adjacent land uses.

A *riparian forest buffer* is a permanent area of trees, usually accompanied by shrubs and other vegetation, that is adjacent to a body of water and is managed to maintain the integrity of stream channels and shorelines; to reduce the impact of upland sources of pollution by trapping, filtering, and converting sediments, nutrients, and other chemicals; and to supply food, cover, and thermal protection to fish and other wildlife. In many settings, grass filter strips may be installed upland of the forest buffer to improve its effectiveness. Riparian buffers are important to the health of living resources in and along streams.

Under natural conditions, riparian forests provide a dynamic yet stable buffering system along most shorelines, rivers, and streams in the bay watershed. Most agree that riparian areas do not have fixed, linear boundaries but vary in width, shape and character. In their natural state, most are forested. And, of the various kinds of buffer vegetation, forest buffers offer the greatest range of environmental benefits.

Do Riparian Buffers Work?

Yes. Studies show that buffers are extremely effective in preventing pollutants from reaching streams. Reasonably sized, properly developed and managed riparian buffers are estimated to be nearly 70 to almost 100 percent effective at filtering nutrients and sediment and from runoff. Without riparian buffers, water treatment plants become more necessary and expensive to operate.

Riparian buffers moderate runoff and protect streambanks. Without riparian buffers, many streams become subject to erosion, widening and down cutting, which generates in-stream sediment pollution and threatens nearby buildings, roads, bridges and utilities.

WHAT ARE THE BENEFITS?

- ***Filtering Runoff***- Rain and sediment that runs off land can be slowed and filtered in the forest, settling out sediment, nutrients and pesticides before they reach streams. It is common for forested buffers to achieve infiltration rates 10-15 times higher than grass turf and 40 times higher than a plowed field.

- ***Nutrient Uptake***- The roots of vegetation absorb fertilizers and other pollutants originating on land. Nutrients are stored in leaves, limbs and roots instead of reaching the stream. Through a process called "denitrification", forest floor bacteria convert harmful nitrate to nitrogen gas, which is released into the air.

- ***Canopy and Shade***- The forest leaf canopy provides shade to keep the water cool, which helps in retaining more dissolved oxygen and encourages the growth of diatoms, beneficial algae and aquatic insects. Also, the canopy improves air quality by filtering dust from wind erosion, construction, or farm machinery.

- ***Leaf Food***- Tree leaves fall into a stream and are trapped on woody debris and rocks, where they provide food and habitat for small, bottom-dwelling creatures (such as insects, amphibians, crustaceans, and small fish) which are critical to the aquatic food chain.

- ***Fish/Wildlife Habitat***- Riparian forest buffers provide the most diverse habitats for fish and other wildlife. Woody debris provides cover for fish while preserving stream habitat over time. Forest diversity is valuable for birds and other wildlife.

- ***Flood Protection***- Riparian forest buffers tend to diminish the force of flood waters, often reducing negative impacts.

TABLE 1

The Effect of Different Size Buffer Zones on Potential Reductions of Sediment and Nutrients from Field Surface Runoff

(from "Lowrance et al", 1995)

Buffer Width ft.	Buffer Type	Sediment Reduction[1] %	Nitrogen Reduction[1] %	Phosphorus[1] %
15	Grass	61.0	4.0	28.5
30	Grass	74.6	22.7	24.2
62	Forest	89.8	74.3	70.0
75	Forest/Grass	96.0	75.3	78.5
95	Forest/Grass	97.4	80.1	77.2

[1]Percent reduction = 100 x (Input - Output)/Input

Another way to measure riparian buffer effectiveness is to compare the cost of establishing and maintaining buffers versus repairing problems created where there are no buffers. These dilemmas are expensive to solve, often involving taxpayer money. Furthermore, experience has demonstrated that structural alternatives that prevent or repair stream channel and shoreline erosion damage are typically much more costly than riparian buffers.

What is the Scientific Viewpoint?

The phenomenon of riparian buffers is not new. They have been under study for 20 years, with knowledge of their values and functions growing rapidly. Yet, it was only recently that scientific research on water quality and ecological functions were applied to managing land use.

"All buffers are not created equal."

COMPONENTS OF A FOREST BUFFER:

- **soil structure/hydrology**
- **organic litter layer**
- **vegetation composition and age**

Scientists agree on the critical habitat functions and research continues to advance technical information about water quality functions of riparian buffers. Studies of natural riparian forests and experimental grass filter strips form the scientific foundation of riparian buffer systems. Although few studies have documented specific water quality changes during a riparian buffer restoration, newly planted buffers are expected to sustain water quality functions similar to a natural system.

In 1995, the Chesapeake Bay Program released a research report, *Water Quality Functions of Riparian Forest Buffer Systems in the Chesapeake Bay Watershed*, by Dr. Richard Lowrance et al. The report firmly supports riparian forest buffers as a pollution prevention tool, describes and quantifies ecological and water quality functions and discusses the predicted effectiveness levels. A non-technical "White Paper" summary is available from the Alliance for the Chesapeake Bay. Table 1 is a sample of information provided about the potential effectiveness of various kinds of buffer systems.

What Are The Considerations?

Here are some issues to consider when establishing priorities for riparian buffer use:

- **Habitat-** Riparian forests are essential for fish and wildlife, especially for migratory birds, providing a place to rest and feed on long journeys. Targeting for habitat enhancement is different than for water quality.

- **Stream Size-** More than 70 percent of Virginia's stream miles is comprised of small streams (orders 1-3) and may be priority areas to reduce nutrients. Establishing riparian buffers along small streams is expected to significantly improve water quality by reducing the high nutrient loads relative to flow volumes typical of small streams.

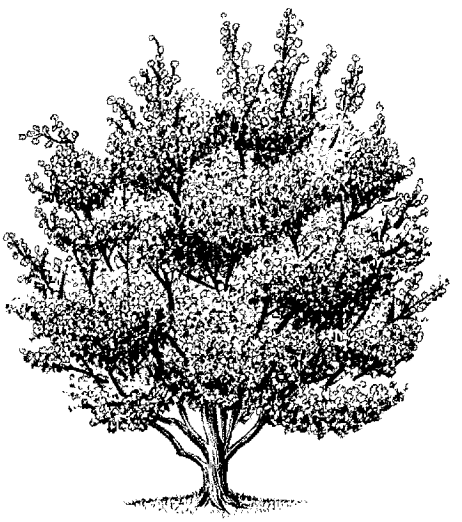
- **Continuous Buffers-** Establishing continuous riparian forest buffers in the landscape should be given a higher priority than establishing larger but fragmented buffers. Continuous buffers provide better stream shading and water quality protection, as well as corridors for the movement of wildlife.

- **Geography-** Water quality benefits of riparian forest buffers may be highest in the Coastal Plain, Piedmont, and specific areas of the Valley and Ridge provinces.

- **Degree of Degradation-** This is directly related to the benefits expected from riparian buffers. Streams in areas without forests, such as pastures, may benefit the most, while highly urbanized/altered streams may not be able to provide high levels of pollution control.

- **Loading Rates-** The removal of pollutants may be highest where nutrient and sediment loadings are the highest.

- **Land Use-** The way the land will be used will influence the width and types of vegetation used to establish a riparian buffer. While the three-zone riparian forested buffers described on the following page are the ideal, they may not always be feasible to establish.



"Water of quality is necessary to support a balanced, integrated, adaptive community of riparian and aquatic organisms comparable to the natural systems of the region, with the stability and capacity for self-repair."

—James Karr, 1978

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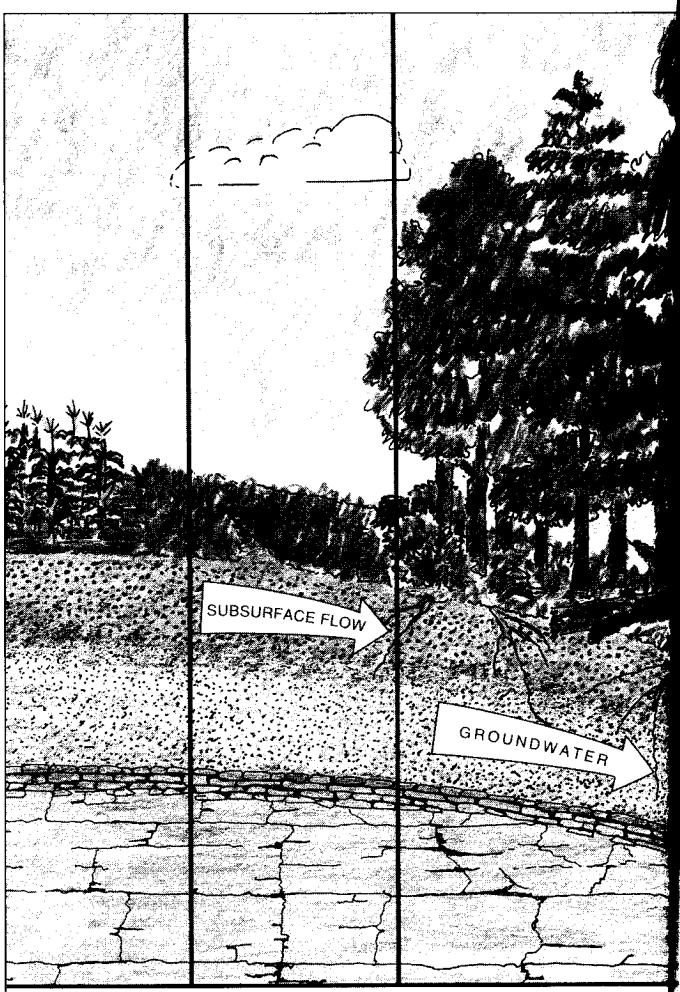
What is a Model Three-Zone Riparian Forest Buffer?

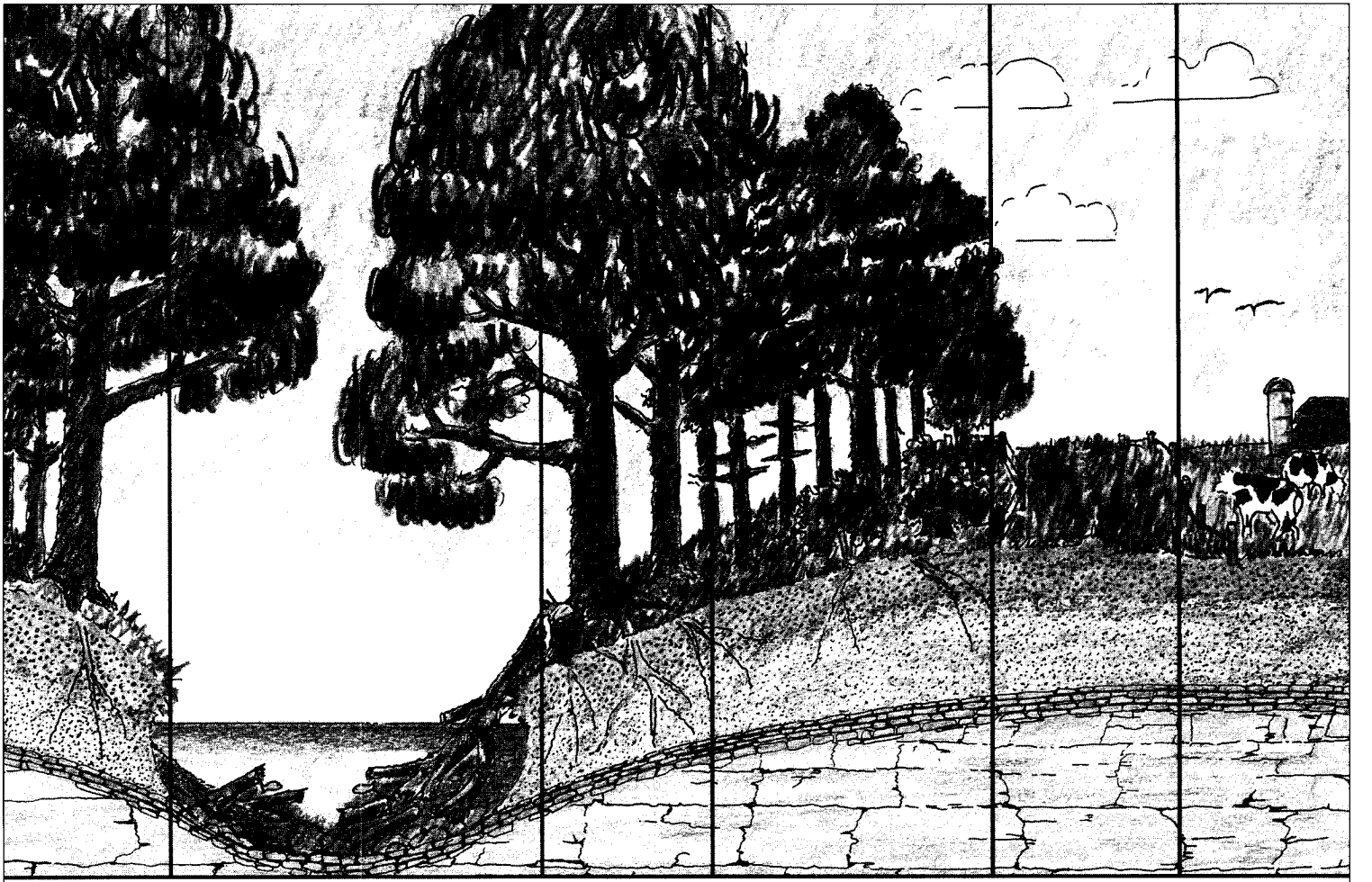
A three-zone buffer system is a model to help plan riparian forest buffers. This highly flexible system is designed to achieve better water quality and other landowner objectives. A three-zone riparian forest buffer may not be necessary or even achievable in every setting, but the model is included in this plan as an example of the best case riparian buffer. The three zones are described below and depicted in the accompanying graphic.

Zone 1- This zone, the inner core of the buffer closest to the water, extends upland from the stream's edge, stabilizing the streambank and providing habitat for aquatic organisms. Here, the tree roots reduce soil erosion by flowing water, and keep sediment and any nutrients bound to it out of the stream. This zone will improve habitat along all streams, with its greatest impact being along smaller streams where the canopy shades the water, providing maximum control over light and temperature. The width of Zone 1 can vary from 15 - 25 feet.

Zone 2- Located immediately landward of Zone 1, this zone protects water quality by removing, transforming, or storing nutrients, sediments and other pollutants. Also, Zone 2 provides food and shelter for hundreds of wildlife species. The width of this zone is typically 50-75 feet. However, it can vary depending on stream order, topography and soil type

Zone 3- Immediately landward of Zone 2, this zone contains grass filter strips or other control measures to slow runoff, filter sediment and related chemicals, and allow water to infiltrate the ground. Grass filter strips help protect the wooded areas and set the stage so the riparian forest buffer can perform at its peak. Zone 3 spreads out the water flow and prevents adjacent land use runoff from eroding channels through the buffer. This enables Zone 2 to effectively trap sediment because the runoff is in the form of sheet flow. The width of this zone generally varies from 20-25 feet.





15'	15'	60'	20'	
ZONE 1 **UNDISTURBED FOREST**	**STREAMBOTTOM**	**ZONE 1** **UNDISTURBED FOREST**	**ZONE 2** **MANAGED FOREST**	**ZONE 3** **RUNOFF CONTROL**	**PASTURE**
Maturing trees provide detritus to the stream and help maintain lower water temperature vital to fish habitat.	Debris dams hold detritus for processing by aquatic fauna and provide cover and cooling shade for fish and other stream dwellers.	Tree removal is generally not permitted in this zone.	Periodic harvesting is necessary in Zone 2 to remove nutrients sequestered in tree stems and branches and to maintain nutrient uptake through vigorous tree growth.	Controlled grazing or haying can be permitted in Zone 3 under certain conditions.	Watering facilities and livestock are kept out of the Riparian Zone insofar as practicable.